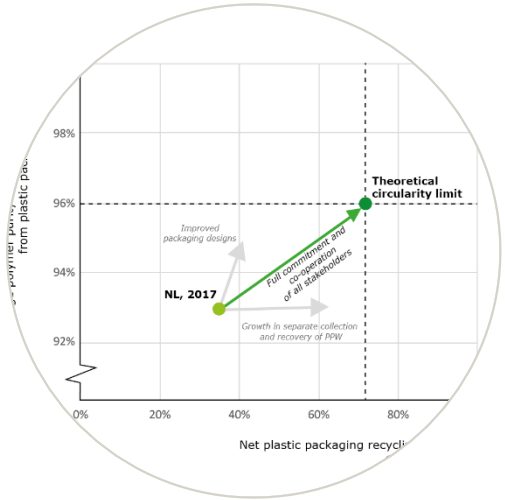
# Packaging design: the key to circular packages

June 15th 2021, Marieke Brouwer





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# Introduction

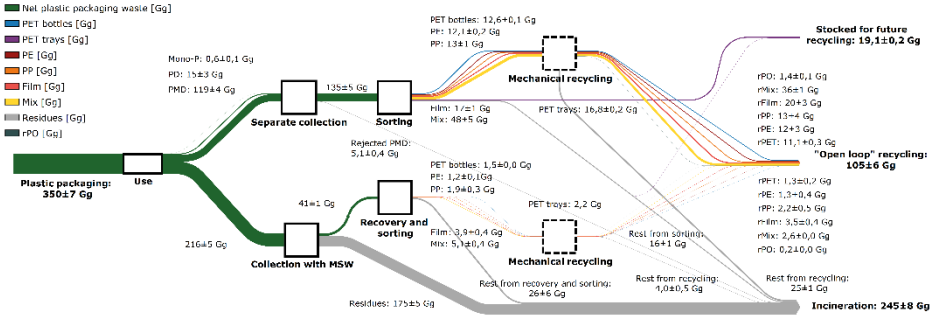

Marieke Brouwer MSc

- Wageningen University & Research
- Researcher Sustainable Packaging and Recycling

- Contact: marieke.brouwer@wur.nl


# Our research on plastic packaging

- **Models** of **Dutch** plastic packaging recycling chain
- **Recyclability** plastic packaging
- And many other related topics



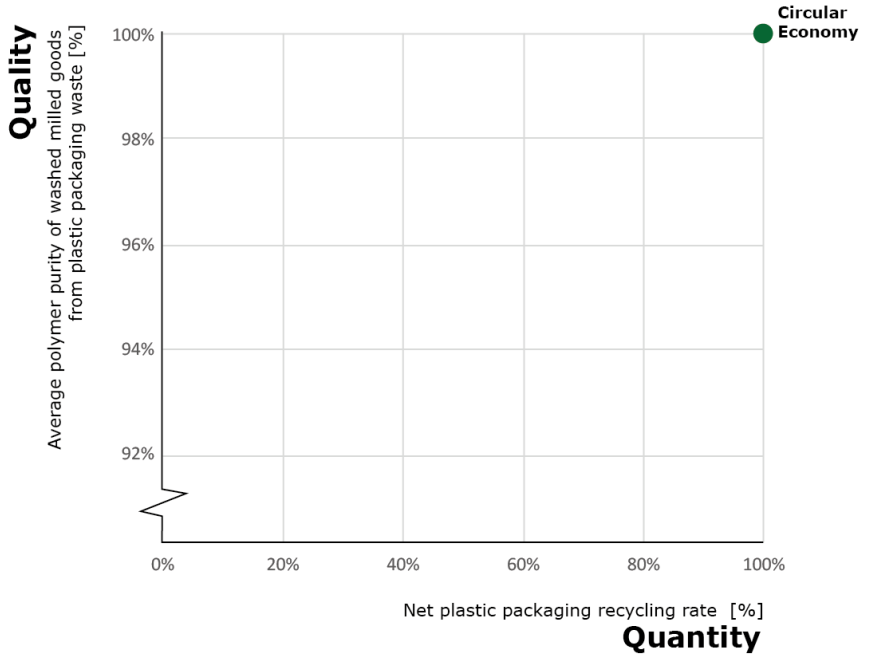

# Circularity performance indicators

**Recycling chain models**:

Calculate the performance of the Dutch recycling chain for plastic packaging waste

**Circularity performance indicators**

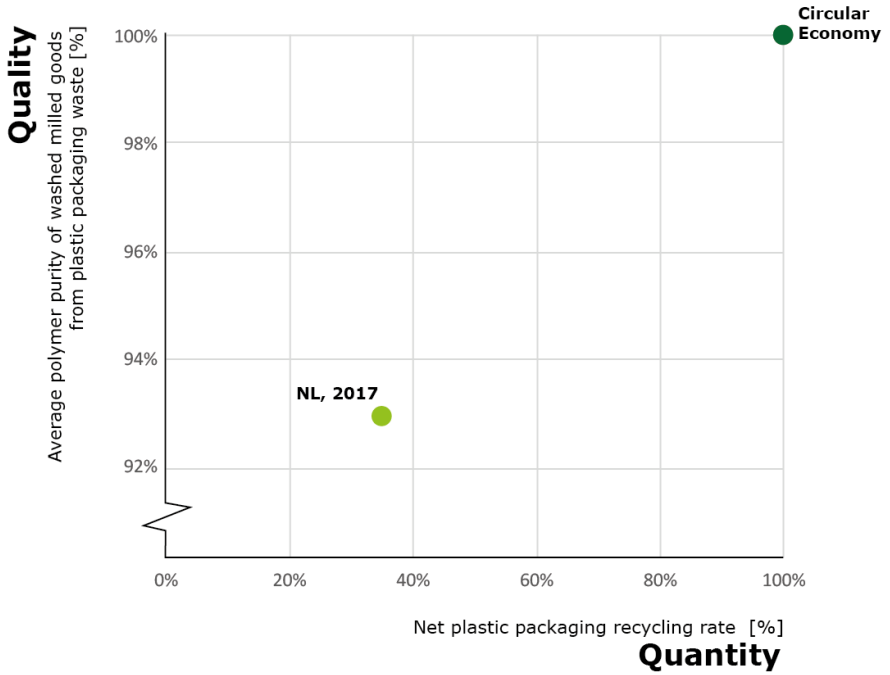
- Quantity: Recycling rate
- Quality: Average polymer purity



# Recycling of plastic packaging waste

**Status 2017**:

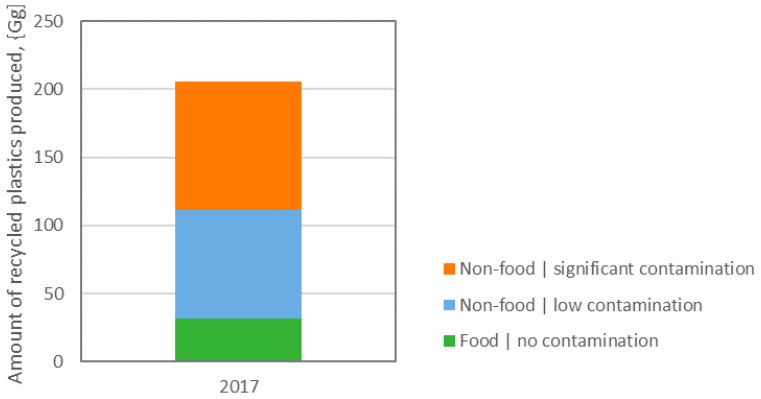
- Recycling rate: 38%
- Average polymer purity: 93%

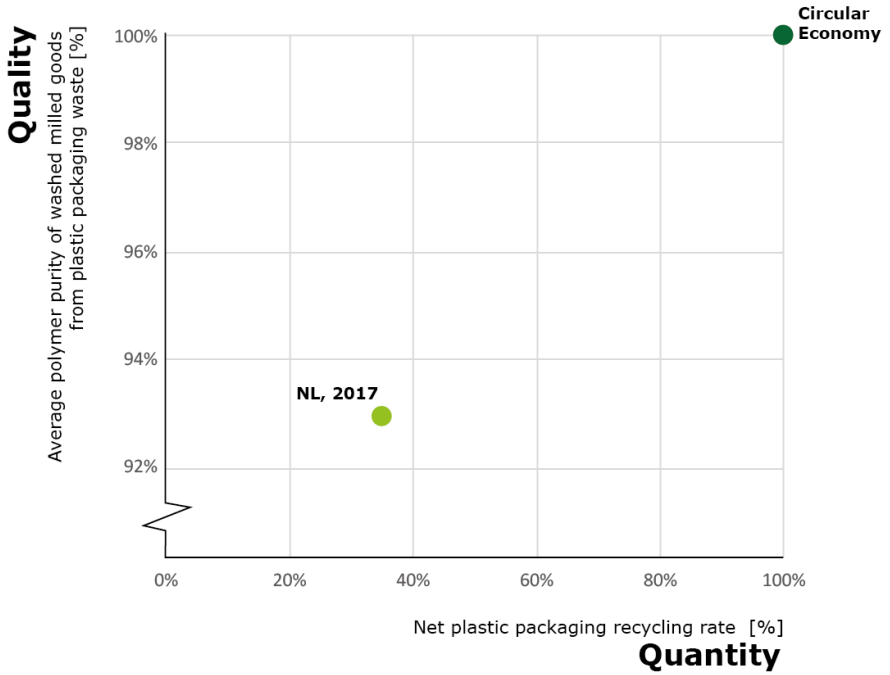


# Recycling of plastic packaging waste

## Applicability of recycled plastics (2017):

- 112 kton of recycled plastics can be used in new packages/consumer products
- 94 kton can only be used in bulky products

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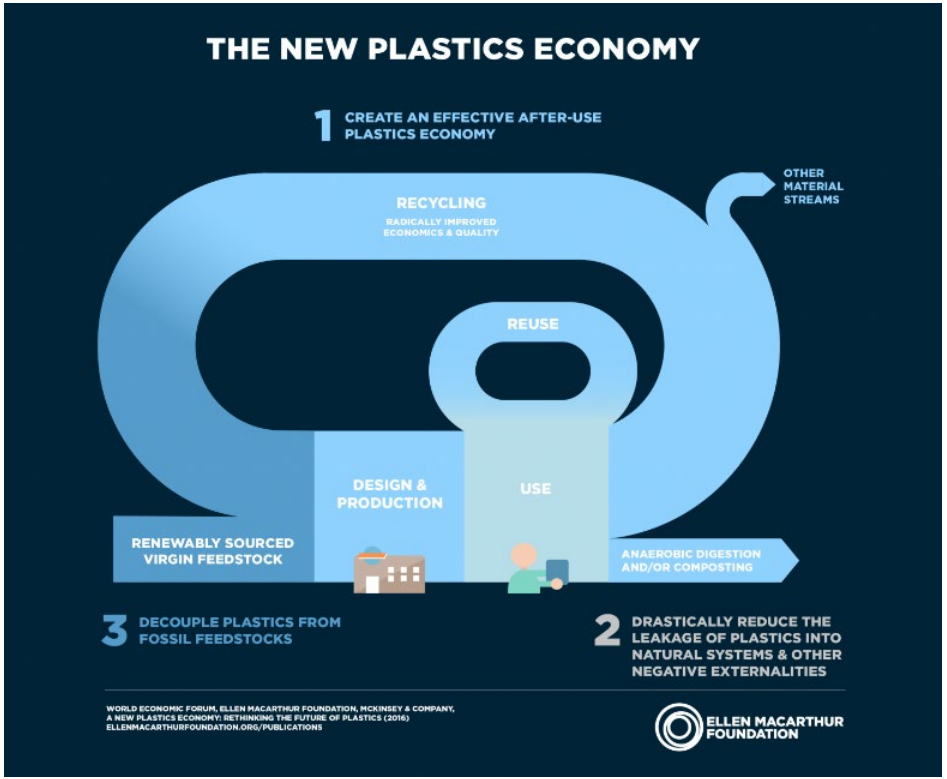
# Goal: circular plastic packages

## Circular plastics

**(Ellen MacArthur Foundation):**

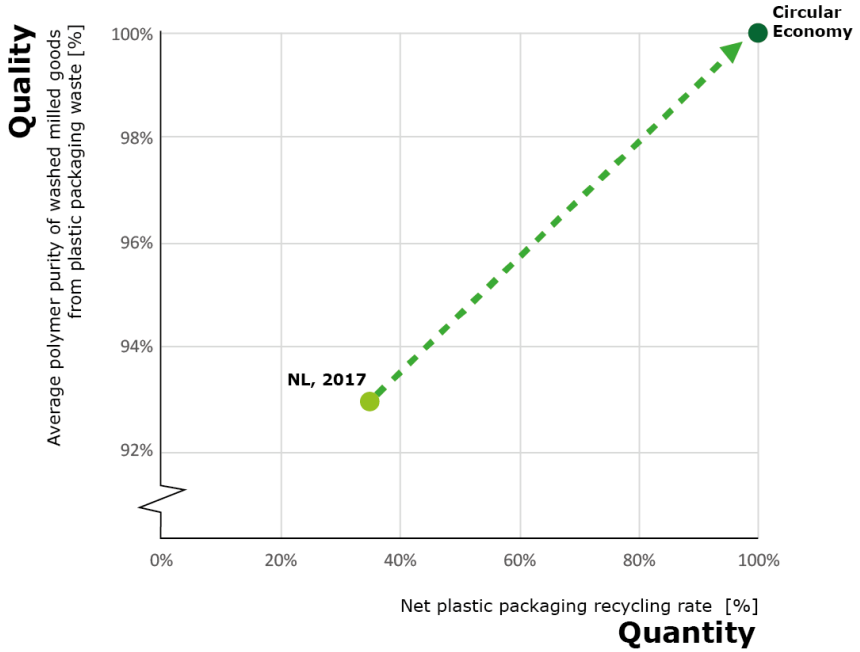
1. Create an effective after-use plastics economy
2. Drastically reduce the leakage of plastics into natural systems & other negative externalities
3. Decouple plastics from fossil feedstocks



# Goal: circular plastic packages

Ideal circular plastic packaging value chain:

- Produce **maximum** amounts of **high-quality** recycled plastics
- Recycled plastics are used in **new packages** and related consumer articles
- Low-quality side-products and material losses are **minimised**.

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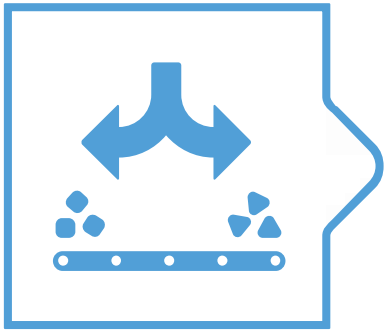
# Prerequisites for an ideal circular PPW chain

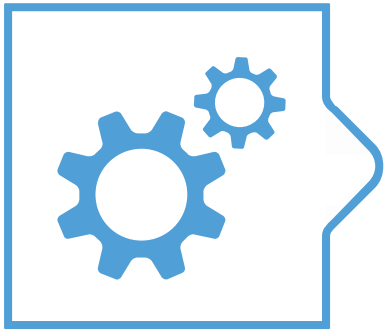
"All stakeholders are completely committed to the performance of this overall system."

**Packaging designs**
fit the recycling scheme

**Collection system**
retrieves all the targeted packaging objects and a minimum of non-targeted materials



**Sorting process**
maximises the production of mono-material sorted products and minimise mixed plastics sorted products



**Recycling technology**
for all packaging materials

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# Circularity potential - modelling

## Modelling the 'best practice' of all stakeholders

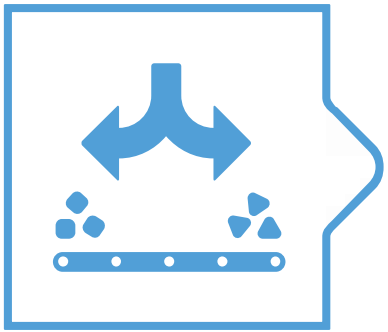
(on the basis of the model for 2017):

**Packaging design**

- PET, PE and PP
- Black → colour
- Performance parameters

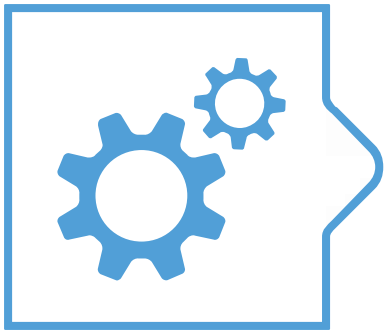
**Collection system**

- Collection rate = 70%
- Less non-targeted contributions



**Sorting process**

- Maximal technical feasible sorting fates
- Additional sorting of PE flexibles



**Recycling technology**

- Additional recycling of PET trays

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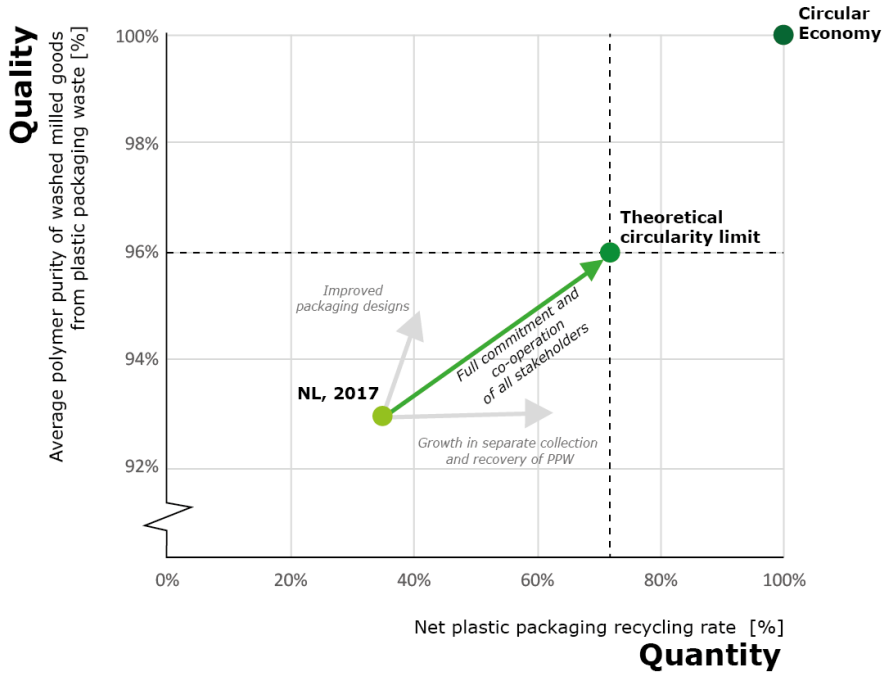
# Circularity potential

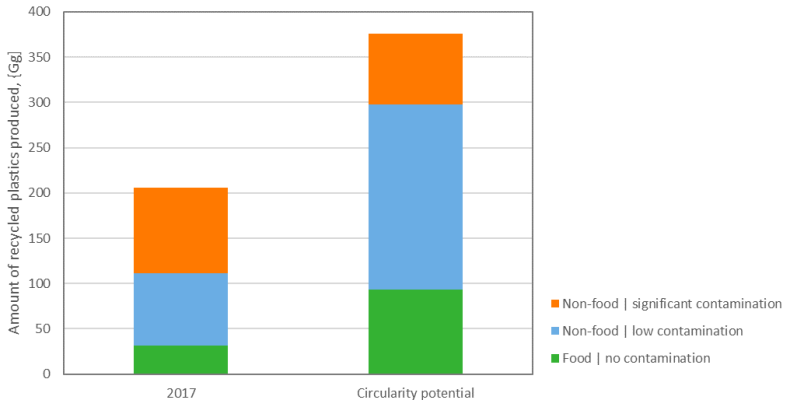
**Circularity potential:**

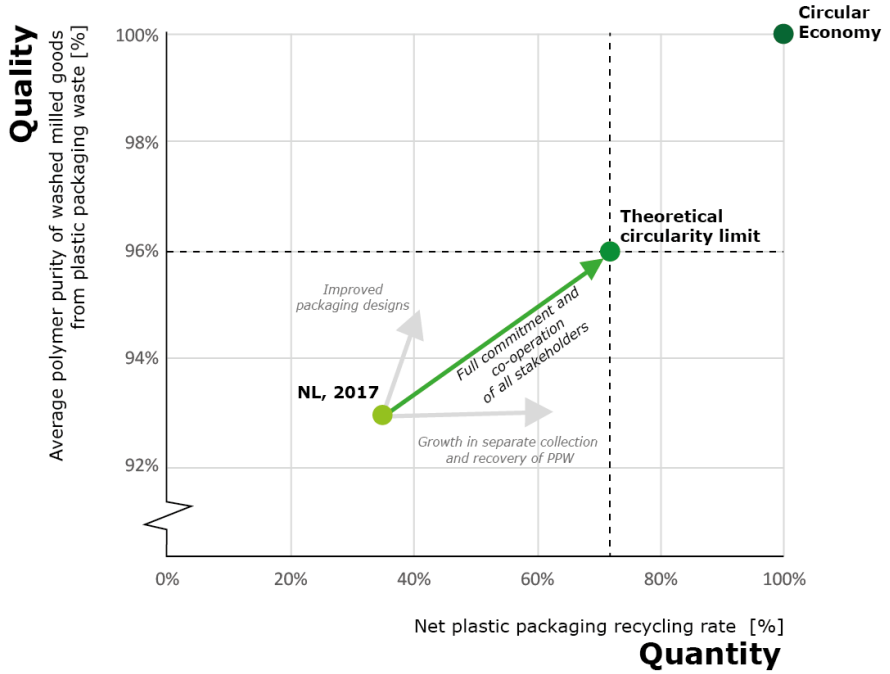
- Recycling rate: 72%
- Polymer purity: 96%



# Circularity potential

- More recycled plastic for food application
- More recycled plastic for new packages/consumer products
- Less recycled plastics for bulky applications

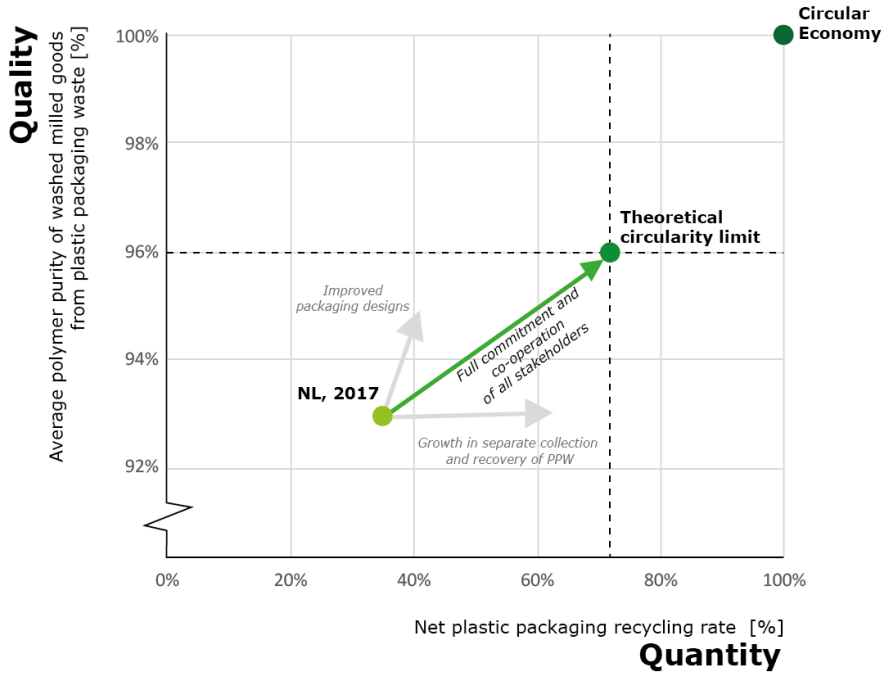


# Circularity potential

**Synergy**:

aligned actions result in **more** and **higher quality** recycled plastics than actions by individual stakeholders

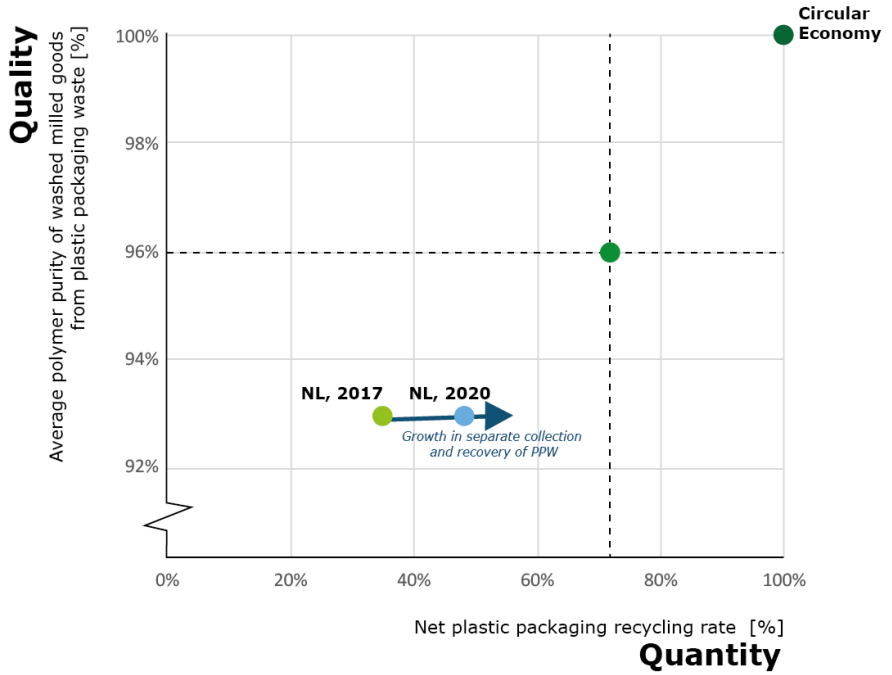


# Recycling of plastic packaging waste

**Status 2020*:**

- Recycling rate: ~48%
- Average polymer purity: ~93%

Higher separate collection rates and additional recovery of PPW resulted in a higher recycling rate.



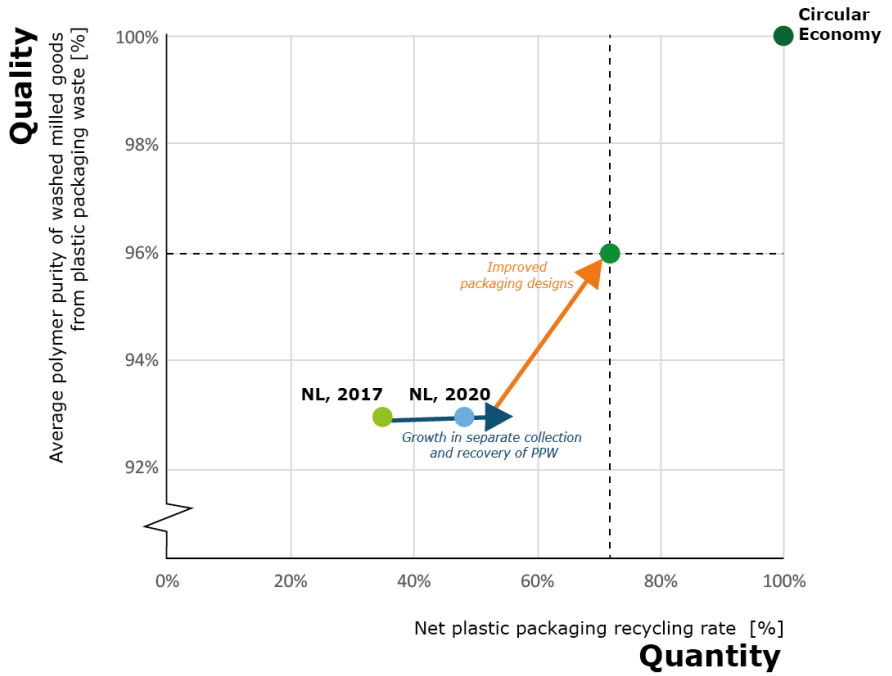

*calculated estimate

# More circular recycling

- The recycled plastics resulting from this system are of **insufficient quality** for the application packages and consumer product

**Design for recycling:**

- improves the quality of the recycled plastics
- improves the chain efficiency



# Recycle guides

- There are many different recycle guides ..
- ... and they are not always consistent

ready to recycle
circpack®


cyclos-HTP
Institut für Recyclingfähigkeit
und Produktverantwortung



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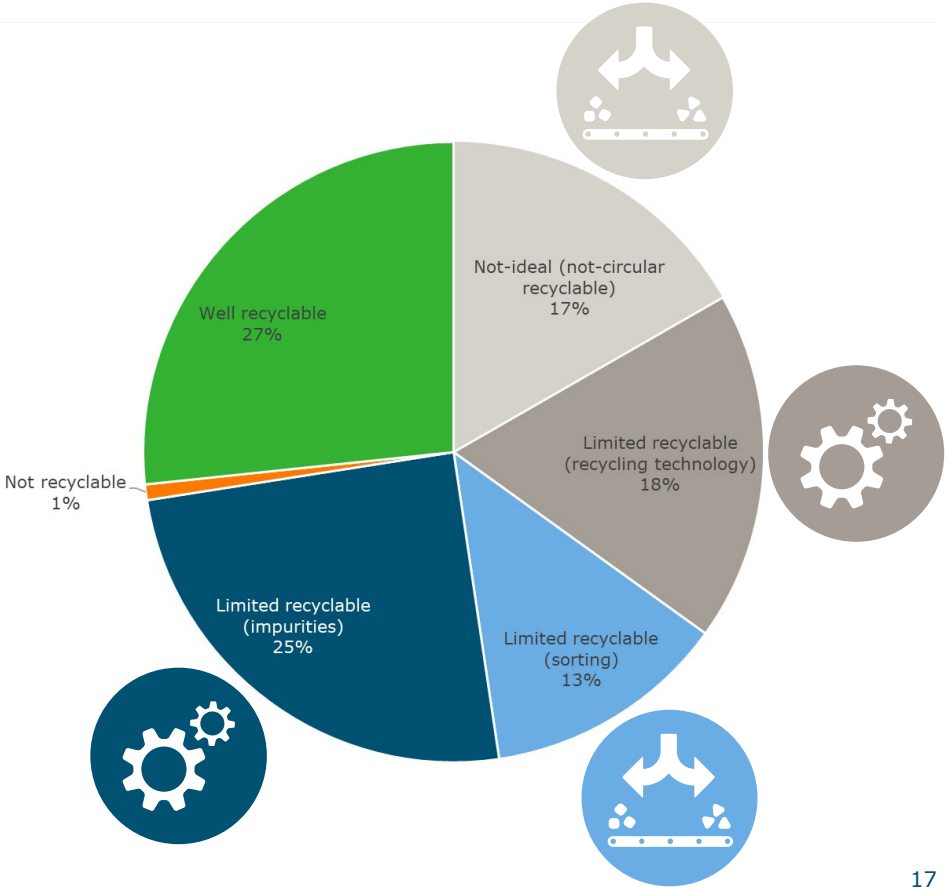
# Packaging design - recyclability

Status 2021:

- 27% of plastic packages is well-recyclable
- Only 1% is not recyclable
- Thus, improvement potential is 72%



# Design for recycling – 4 key principles

"Individual packages will have to be **easy to handle** in **all different stages** of the PPW recycling system."

4 key principles:

"Additionally, the packaging materials should be able to fulfil the packaging functions to prevent environmental burdens such as food losses."

# Design for recycling – 4 key principles

Principle 1:

**All** packages in the system should

- be made of a restricted **amount** of plastics
- that can be **efficiently** separated and processed
- with **simple** technologies.

# Design for recycling – 4 key principles

Principle 2:

The packaging design should

- **facilitate** collection.

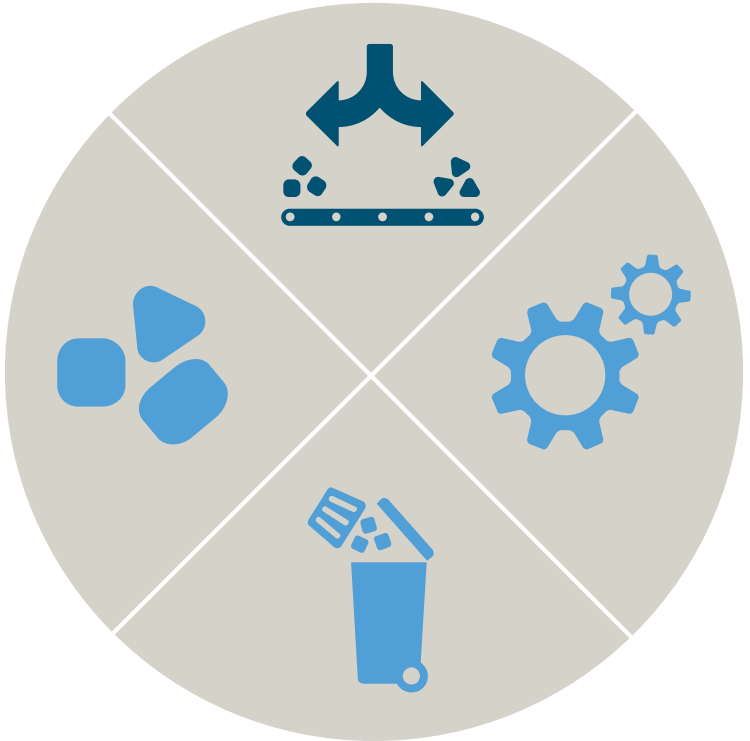
(Easy to recognize as recyclable/plastic packaging)

# Design for recycling – 4 key principles

Principle 3:

The packages should

- be **easily recognised** by automatic sorting machines
- and its **dimensions** should enable sorting.



# Design for recycling – 4 key principles

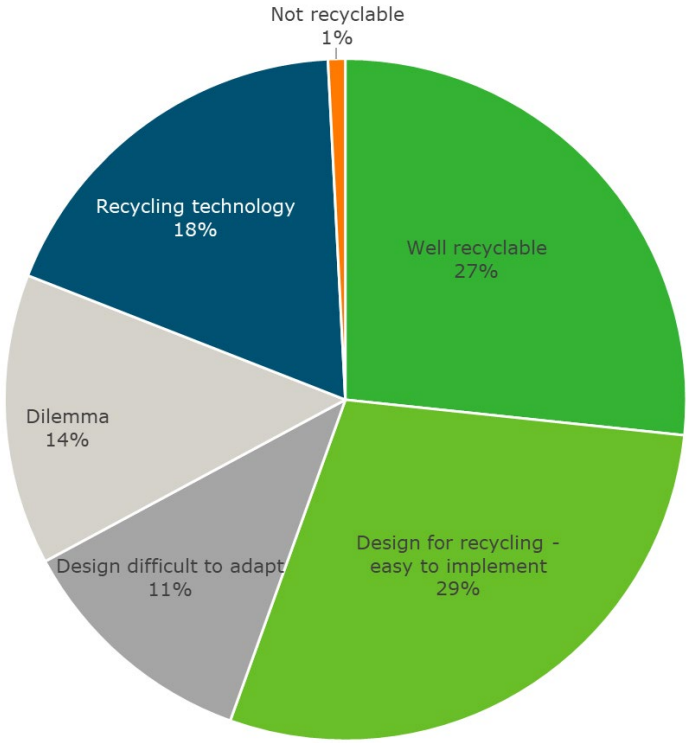
Principle 4:

The packaging **components** (often made from different polymers and materials) should

- be easy to separate in an efficient manner in the recycling process.

# Design for recycling oppertunities

- 29% easy to implement
- 11% difficult to adapt
- 14% dilemma’s (e.g. food waste)
- 18% recycling technology



# Easy to implement (29%)

Packaging components that cause impurities (16%):

- Pump & spray mechanisms


- Unremovable (paper) labels

- Metal caps, silicone rings, etc.

# Easy to implement (29%)

Big labels & sleeves (~3%)


Black packages (~7%)

# Difficult to adapt (11%)

## Small packages




# Dilemma (14%)

Laminated films and rigids (~7.5%)

PP films (~6%)


Blisters for pills (~0.5%)

# Recycling technology (18%)

- PET trays


- PS packages


# Effect of design for recycling

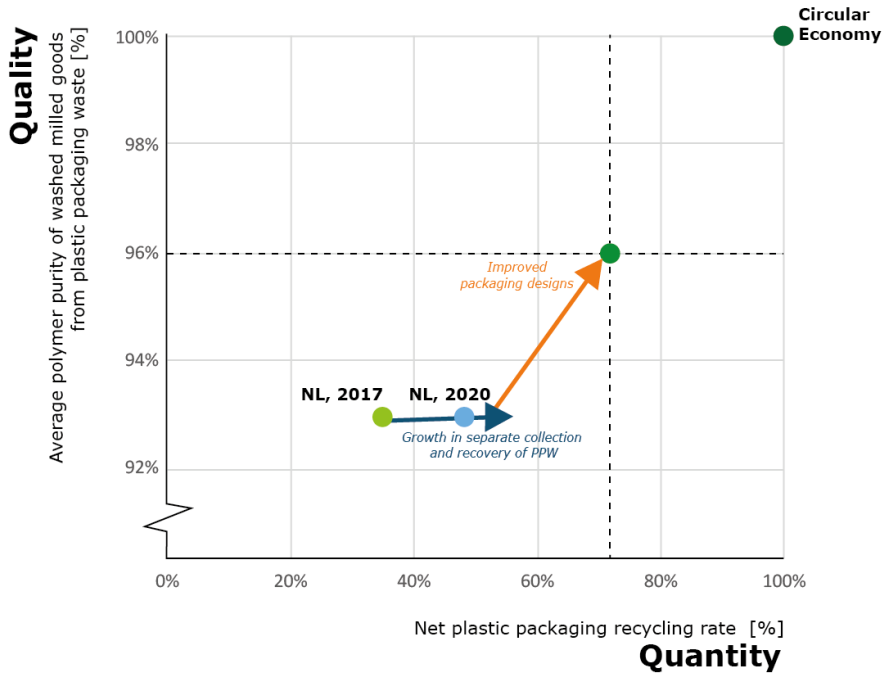
**Design for recycling:**

- improves the quality of the recycled plastics

AND

- improves the chain efficiency

So, by **re-designing** the plastic packages we will move towards a **more circular** plastic packaging value chain



# Effect of design for recycling

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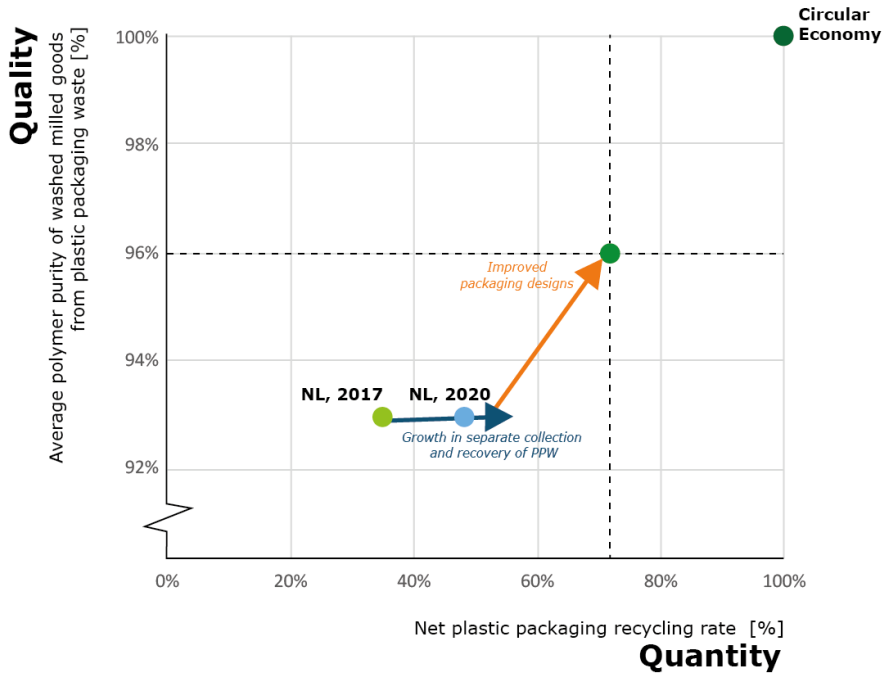
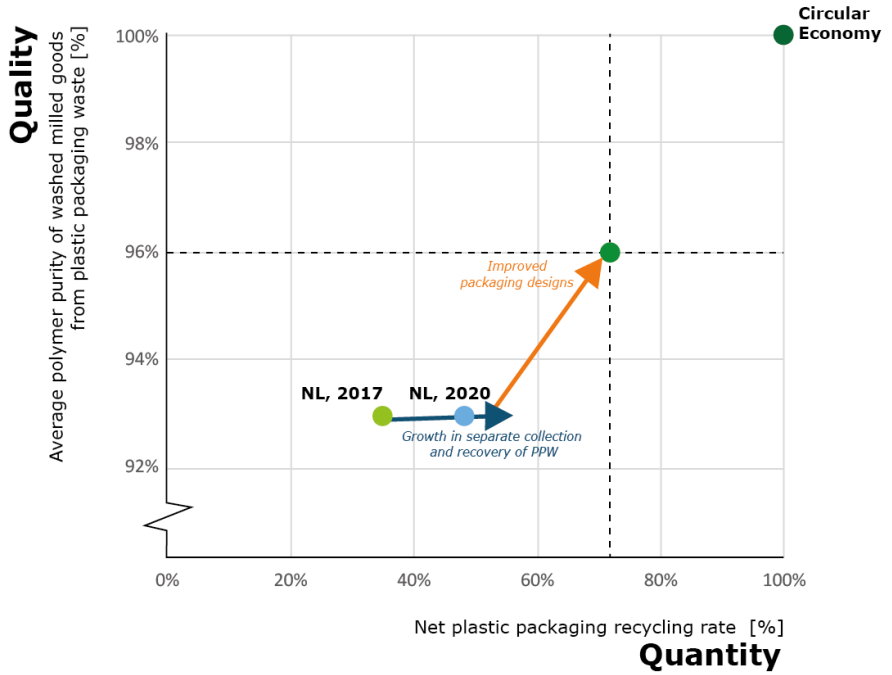


# Beyond the limit

More **circular** recycling, larger share of recycled plastic can be used in **new packages** …

…. but still, the value chain:

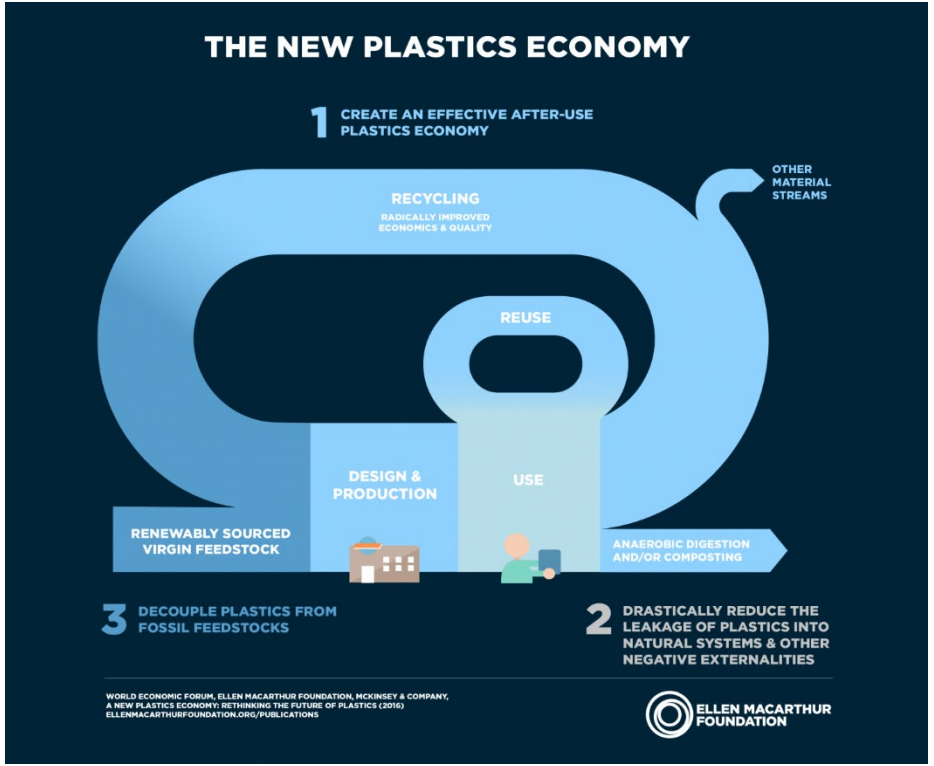
- is dependent on oil as input
- produces a share of recycled plastic that
  - is not applicable in food applications
  - is only applicable in bulky products



# Beyond the limit

A truly circular system, also:

- Uses renewable resources
- Processes inevitable waste
- Reduces leakage to environment

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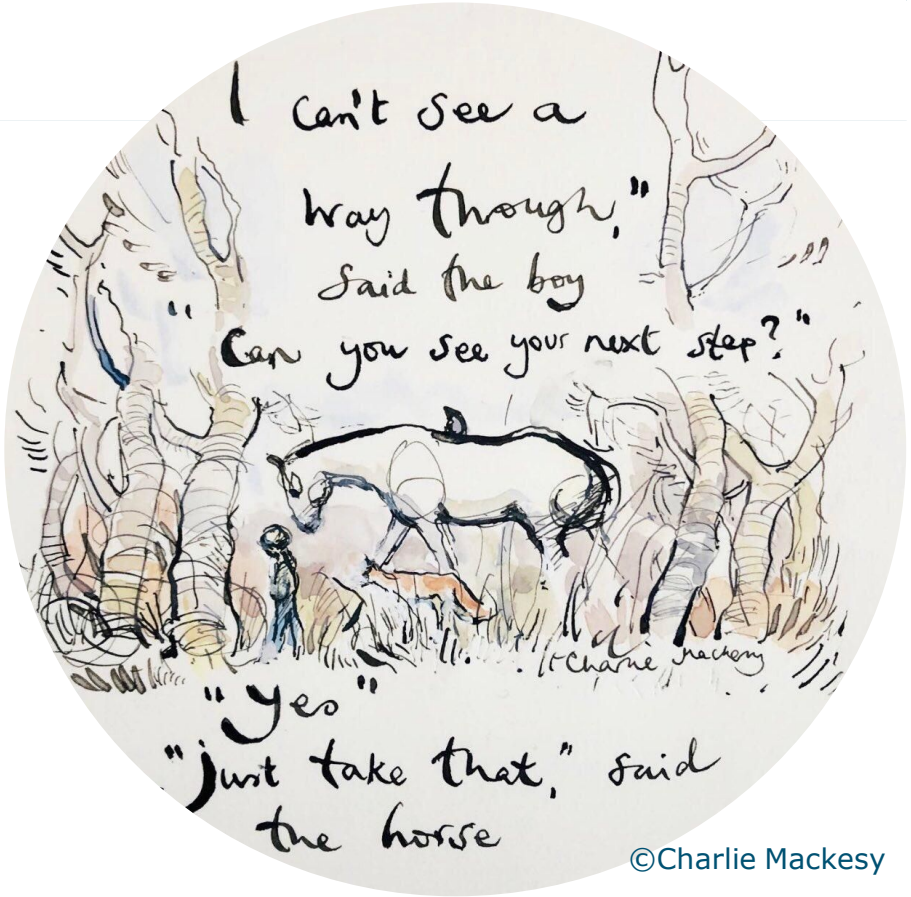
*Plastic packaging waste

# Future perspective

A long way to go to produce a **truly circular** packaging system ....

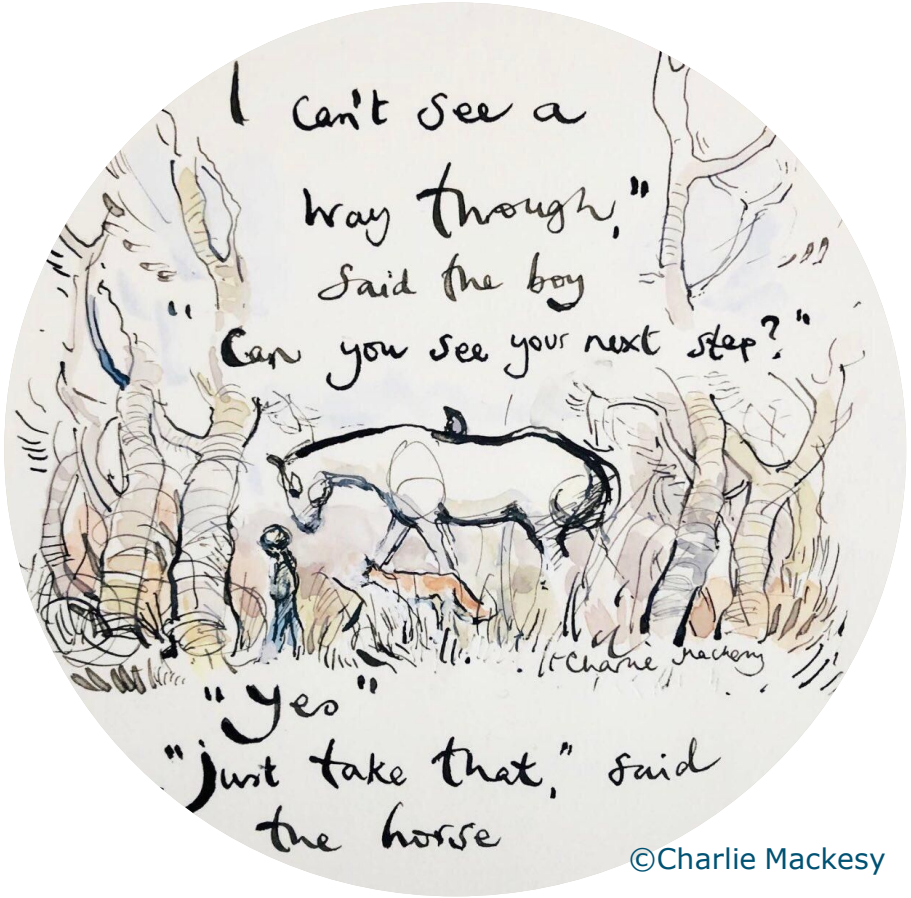
... but **step-by-step** we will get closer ...

... and the **next step** should be **re-designing** plastic packages.



# Thanks!

Questions?




Contact: marieke.brouwer@wur.nl

# Related publications

## Recyclability of plastic packages (Dutch):


- Brouwer, M., Thoden van Velzen, U., & Workala, Y. (2021). Recyclebaarheid van Nederlandse kunststofverpakkingen : de status van 2021. (Rapport / Wageningen Food & Biobased Research; No. 2150). Wageningen Food & Biobased Research. https://doi.org/10.18174/546479

- Brouwer, M. T., & Thoden van Velzen, E. U. (2017). Recyclebaarheid van verpakkingen op de Nederlandse markt: Huishoudelijke kunststof verpakkingen in sorteerproducten onderzocht op recyclebaarheid en hoeveelheid. (Wageningen Food & Biobased Research report; No. 1782). Wageningen Food & Biobased Research. https://doi.org/10.18174/427519


## Models of the Dutch plastic packaging waste recycling chain (English):


- Brouwer, M. T., Thoden van Velzen, E. U., Ragaert, K., & ten Klooster, R. (2020). Technical Limits in Circularity for Plastic Packages. Sustainability (Switzerland), 12, 1-29. [122310021]. https://doi.org/10.3390/su122310021

- Brouwer, M., Picuno, C., Thoden van Velzen, E. U., Kuchta, K., De Meester, S., & Ragaert, K. (2019). The impact of collection portfolio expansion on key performance indicators of the Dutch recycling system for Post-Consumer Plastic Packaging Waste, a comparison between 2014 and 2017. Waste Management, 100, 112-121. https://doi.org/10.1016/j.wasman.2019.09.012

- Brouwer, M. T., Thoden van Velzen, E. U., Augustinus, A., Soethoudt, H., De Meester, S., & Ragaert, K. (2018). Predictive model for the Dutch post-consumer plastic packaging recycling system and implications for the circular economy. Waste Management, 71, 62-85. https://doi.org/10.1016/j.wasman.2017.10.034